



Competition and Concentration:

How the Tech/Telecom/
Ecommerce Sector is
Outperforming the Rest
of the Private Sector

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INTRODUCTION AND SUMMARY

The U.S. economy almost certainly has a problem with rising market power. A bevy of recent economic studies show that concentration in many sectors of the economy has increased over the past 20–30 years. These increases in concentration have been convincingly linked to such economic ills as rising prices, weak productivity growth, stagnant real wages, slower job growth, weak investment, and falling labor share.

Indeed, there is little doubt that strong and consistent competition policy plays an important role in a market economy. Long-standing incumbents in a wide range of industries can exercise market power to choke off innovation and growth, protecting the status quo and driving up prices rather than benefiting workers and consumers.

Yet, when examined closely, the research on concentration and competition does not single out the tech/telecom/ecommerce sector—otherwise known as the digital economy—as a particular problem. An important study from MIT economist David Autor and a group of distinguished colleagues found a “remarkably upward consistent trend in concentration” across manufacturing, finance, retail trade, wholesale trade, utilities and transportation, and services.¹ In particular, Autor et al. show that most of the rise in concentration in services happened in the 1990s and early 2000s, when Facebook, Google, and Amazon either didn’t exist or were very small, and when Apple was still struggling pre-iPhone.

So the first goal of this paper is to analyze whether the tech/telecom/ecommerce sector in fact suffers from the economic ills described above. **We find that the tech/telecom/ecommerce sector convincingly outperforms the rest of the non-health private sector on every important economic metric, benefitting customers and workers.** The second goal of the paper is to explain why apparent high concentration in the tech/telecom/ecommerce sector may be misleading.

We start with some context on scale. In 1969, the United States was at the height of its global manufacturing power. The revenue of the top four industrial giants – General Motors, Ford, General Electric, and IBM – totaled 5.4 percent of U.S. gross domestic product (GDP) and a stunning 2.0 percent of global GDP.

Today, the U.S. is the leading global tech power, rivaled perhaps only by China. But the revenue at today's four U.S. tech leaders – Apple, Amazon, Google, and Facebook – totals only 2.9 percent of U.S. GDP and only 0.7 percent of global GDP. That includes all their revenues from smartphones, ecommerce, advertising, and other sources.

Moreover, we find that the relative size of the tech/telecom/ecommerce leaders has barely changed since 2000, the peak of the last tech boom. **Revenues at the U.S. tech/telecom/ecommerce leaders did rise from 2000 to 2017—but no faster than the expansion of the global economy.**

We also find that the tech/telecom/ecommerce sector has outperformed the rest of the non-health private sector across a wide range of important economic measures since the tech boom started in 2007. Productivity rose

by almost 60 percent in the tech/telecom/ecommerce sector between 2007 and 2017, compared to only 5 percent in the rest of the non-health private sector. **Because of these gains, the tech/telecom/ecommerce sector accounted for almost half of non-health private sector growth between 2007 and 2017.**

Over the same period, prices in the tech/telecom/ecommerce sector fell by 15 percent, compared to a 21 percent increase in the rest of the non-health private sector. It wasn't just one digital price that fell. Online advertising prices have fallen by more than 40 percent since 2010. Cloud computing prices have been falling at 7 percent per year. Real margins in the electronic shopping industry (NAICS 4541) have fallen by 13 percent since 2007, implying increased competitiveness. These price drops represent real gains to customers.

On the labor side, real annual pay per worker rose by 15.4 percent in the digital sector between 2007 and 2017, compared to a 7.0 percent gain in the rest of the non-health private sector. Perhaps surprising, employment also grew faster in the digital sector, 14.0 percent versus 3.3 percent for the rest of the non-health private sector. Job growth was fueled by an expansion at a combination of big and small companies, or, rather, once small tech/ecommerce companies becoming larger. For example, Amazon went from 17,000 workers in 2007 to 566,000 in 2017. Apple went from 21,600 workers in 2007 to 123,000 in 2017.

The combination of rising pay and increased employment means that payments to labor in tech/telecom/ecommerce have kept up with the rapidly expanding industry. **As a result, the labor share in the tech/telecom/ecommerce sector has stayed flat since 2007.**

By contrast, the labor share in the rest of the non-health private sector has fallen by 1.3 percentage points.

In other words, the companies in the tech/telecom/ecommerce sector are subject to sufficient competitive pressures that they are distributing their rapid productivity gains to customers in the form of falling prices – and to workers in the form of higher real pay and more jobs.

The second half of the paper examines the competitive pressures on the tech/telecom/ecommerce companies. Typically these companies appear to have a very large share of their individual activity by conventional metrics. The usual numbers cited are Google, with roughly 85 percent of desktop search in the United States – which doesn't account for the large number of searches done within sites such as Amazon, LinkedIn, and Etsy – and Amazon, with an estimated U.S. ecommerce share of just under 50 percent, including sales of third-party sellers using Amazon Marketplace.² A recent Pew Research Center survey shows that 68 percent of U.S. adults use Facebook, and, out of those, roughly half visit multiple times daily.³

But these apparently high-concentration indices do not necessarily correlate with low competitive pressure. We look at different aspects of the relevant markets.

- **Multi-sided markets and platforms:** The largest tech companies are important players in multi-sided markets, also known as digital platforms. Multi-sided markets are defined as online markets or platforms where the digital company that owns the platform brings together two or more groups of users for beneficial transactions. Recent research suggests that high concentration in one side of the market may give a

misleading impression of overall market power. In particular, platforms have a strong incentive to maintain user trust. If that trust is broken, then it is easy for users to find an alternative platform. Moreover, conventional economic statistics may underestimate the efficiencies generated by digital platforms. The major efficiency gain from ecommerce platforms, for example, may be the reduction of household time spent shopping, which has fallen by 20 minutes per week per adult since 2007. That comes to an aggregate weekly decline of 90 million hours, which significantly increases the gain from ecommerce.

- **Online retail:** Ecommerce originally had characteristics different from brick-and-mortar sales. But technological innovation in the distribution system enables ecommerce sellers to offer rapid delivery and easy returns at a low price, making ecommerce purchases essentially equivalent to brick-and-mortar sales. On that basis, Amazon has only 5 percent of the retail market. Real margins in the electronic shopping industry (NAICS 4541) have fallen by 13 percent since 2007, implying increased competitiveness. Meanwhile real margins in the general merchandise industry, including department stores and big box retailers, have fallen by only 6 percent.
- **Online advertising:** As in the case of ecommerce, the nature of Internet advertising has evolved. Internet advertising and television used to be seen as different markets, when online advertising was mostly display ads as compared to highly-produced television commercials. Now the increased prevalence of online video ads means they are increasingly seen as overlapping markets. According to the Bureau of Labor

Statistics, the price of Internet advertising has dropped more than 40 percent since 2010, while the price of television advertising has remained flat.

- **Multi-homing and network effects:** By itself, a network effect would imply that, once a network gets a large enough share of the relevant market, it becomes entrenched and hard to challenge. In practice, however, the network effect is attenuated by “multi-homing.” A 2018 study from the Pew Research Center shows that the typical (median) American uses three of the social networks surveyed. Pew finds that among 18- to 24-year-olds, 80 percent use Facebook and 78 percent use SnapChat. These results suggest that digital natives feel comfortable switching back and forth among platforms.
- **Data feedback loops and barriers to entry:** The persistent analogy between oil and data completely collapses under close examination. A more sophisticated argument about data and market power revolves around the “data feedback loop.” The idea is that a company with a large amount of data about its customers can use that data to make its products and services more attractive. But new research suggests diminishing returns to scale to data in some important platform-related situations. In a 2017 paper, Lesley Chiou and Catherine Tucker found little evidence that the possession of historical data conferred large advantages in search engine results. Patrick Bajari, chief economist at Amazon, recently worked with two academic economists to answer the question: Does having access to more data allow Amazon to improve forecasts of consumer demand for particular products? They found that aggregating data

across different products did not seem to be associated with increases in forecast performance. This supports the idea that data feedback loops are not necessarily a barrier to entry.

- **Competition in the cloud computing market:** If possession of data does not create barriers to entry, then perhaps limited access to computing power for data analysis does? Recent economic research suggests that the price of cloud computing has been falling. Economists David Byrne, Carol Corrado and Daniel Sichel estimate that prices for the Amazon Web Services (AWS) compute product fell at an average rate of about 7 percent during 2000-2016. Price declines were slower before 2014 and more rapid starting in the beginning of 2014. As recently as August 2018, Google cut the monthly cost of storage in half.
- **The rise of new platforms in physical industries such as manufacturing and healthcare:** Much of the “physical” economy – such as key industries like manufacturing, construction, and healthcare – have been much slower to digitize. That will change, however, as the next decade will see the digitization of physical industries. In manufacturing, for example, the growth of robots and 3D will give manufacturers the ability to efficiently fulfill small-batch or custom production runs without incurring heavy retooling costs. Moreover, the digitization of manufacturing production will lead to industrial companies creating manufacturing platforms, both open and proprietary. These new platforms will have the potential to rival the existing tech companies.

- **The rise of global competition in the tech/telecom/ecommerce space:** Historically, assessing the geographic bounds of a market was an important consideration in measuring concentration and competition. But conceptually, the tech/telecom/ecommerce markets are global. Moreover, individuals and businesses can participate in multiple platforms based in different countries. A business can sell through Amazon in the U.S., Rakuten in Japan, and Jingdong or Alibaba in China. Even if such sales are relatively small right now, these platforms have the scale to quickly expand across borders. European rules in areas such as data privacy acknowledge the global nature of the Internet. In that sense, antitrust regulators should weigh the potential global competition when considering concentration in U.S. markets. That's why, in the early part of this paper, it was relevant to compare the size of the tech/telecom/ecommerce leaders with the size of the global economy.

Our conclusion is that conventional metrics of concentration underestimate the degree of competition in the tech/telecom/ecommerce sector, given the way markets have evolved. In terms of policy, our conclusions suggest a sector-agnostic approach to competition policy. Regulators need to be alert for potential problems, but the strong economic performance of the tech/telecom/ecommerce sector across a range of measures makes it less likely that the tech giants are engaging in anticompetitive behavior on a wide scale. Moreover, we anticipate that the next decade of digitization will be larger and more disruptive than the past decade.

BACKGROUND

Recent economic research suggests concentration in many industries has increased in the United States and Europe, and that market power has become more prevalent across much of the economy. MIT economist David Autor and a group of distinguished colleagues found a “remarkably upward consistent trend in concentration” across manufacturing, finance, retail trade, wholesale trade, utilities and transportation, and services.⁴ Jason Furman, while he was head of Obama’s Council of Economic Advisors, noted that evidence for rising concentration has been found in such diverse industries as agriculture and hospitals.⁵ Gustavo Grullon and colleagues report that more than 75 percent of U.S. industries have experienced an increase in concentration levels over the past two decades.⁶

The same story seems true in Europe as well. Chiara Criscuolo finds a rise in concentration across a subset of industrialized countries, while Tommaso Valletti et al. find mixed evidence for an increase in concentration in Europe.^{8,9}

Growing evidence suggests that the lack of competition can hurt macroeconomic performance. Researchers have linked a rise in concentration to economic ills such as rising prices, weak productivity growth, stagnant real wages, slower job growth, weak investment, and increased inequality.

The classic theory of market power, of course, links concentration and market power to the ability to raise prices above competitive levels. In that vein, Jan De Loecker and Jan Eeckhout found a rise in average markups in the U.S. from

18 percent above marginal cost in 1980 to 67 percent today – and a roughly similar increase globally as well.¹⁰ Looking over 26 countries, Sara Calligaris and colleagues find a rise in markups in the period 2001-2014.¹¹

More broadly, a 2016 report from the Obama Council of Economic Advisors argued that “monopolists may be less rigorous in pursuing efficient cost reductions,” implying that increased concentration may be one reason productivity growth has been weak in recent years.¹² Along the same lines, incumbent businesses with market power may have the ability to resist disruption by new technologies. Regulation can sometimes set up barriers to entry that reduce competition from small companies. Some observers have suggested that the market power of large companies undercuts innovation by making it harder for small innovative companies to thrive and expand.¹³

Germán Gutiérrez and Thomas Philippon show that industries with more concentration and more common ownership invest less – even after controlling for current market conditions.¹⁴

Nicolas Crouzet and Janice Eberly link weak capital investment to increases in market concentration.¹⁵

Industries with more concentration and more common ownership invest less – even after controlling for current market conditions.

Economists have also found evidence that concentration has a negative effect on the labor market – jobs, wages, and inequality. To begin with, if monopolists push up prices by restricting output, as theory would suggest, that is likely to hold down hiring as well. Moreover, slower

productivity growth would typically translate into slower real wage growth. And market power has the potential to translate into lower wages. Jose Azar, Ioana Marinescu, and Marshall Steinbaum argue that an increase in employer concentration in a local region lowers pay levels in that region significantly – a result with intuitive appeal.¹⁶

Perhaps most importantly, Autor et al. linked an increase in market concentration in an industry to a reduction of the percent of industry output going to workers – the labor share. In this way, increased concentration can contribute to a growing disparity of income between workers and owners of capital.¹⁷ Sharat Ganapati also finds that industry concentration increases are negatively correlated with labor’s revenue share.¹⁸

THE RELATIVE SIZE OF THE TECH GIANTS IN HISTORICAL CONTEXT

The economic research on concentration is often explicitly motivated by the apparent market dominance of companies such as Google, Amazon, Apple, and Facebook. Yet, when examined closely, the economic studies on concentration and competition tell us far more about the rest of the economy than they do about the digital leaders. The great majority of the economic studies cited above are focused on 20-year and 30-year trends across the entire economy, and have very little to say directly about the current tech boom. The widely-cited study by Autor et al., for example, shows that most of the rise in concentration in services happened in the 1990s and early 2000s, when Facebook, Google, and Amazon either didn’t exist or were very small, and before Apple was revived by the iPhone.

Moreover, the big tech firms are often accused of exerting undue influence because of their

size. But a historical comparison with the industrial giants of the past gives a different perspective. Take 1969 – a business cycle peak and the culmination of a prosperous decade for Americans. In that year, the revenue of the top four industrial companies – General Motors, Ford, General Electric, and IBM – was equal to a stunning 5.4 percent of U.S. GDP, and 2.0 percent of global GDP (Figures 1 and 2). By comparison, as of 2017 the revenues of the four leading tech companies – Apple, Amazon, Google, and Facebook – were only 2.9 percent of U.S. GDP, and 0.7 percent of global GDP.

In other words, today's tech leaders are much smaller than their industrial predecessors, relative to the size of the U.S. and global economies. The same holds true if we look at the top 15 industrial companies in 1969 (a list that includes Bethlehem Steel, Eastman Kodak, and Boeing) versus the top 15 tech/telecom/ecommerce companies in 2017 (which includes AT&T, Verizon, and Comcast). Once again, the 1969 industrial leaders were significantly bigger, in relative terms.

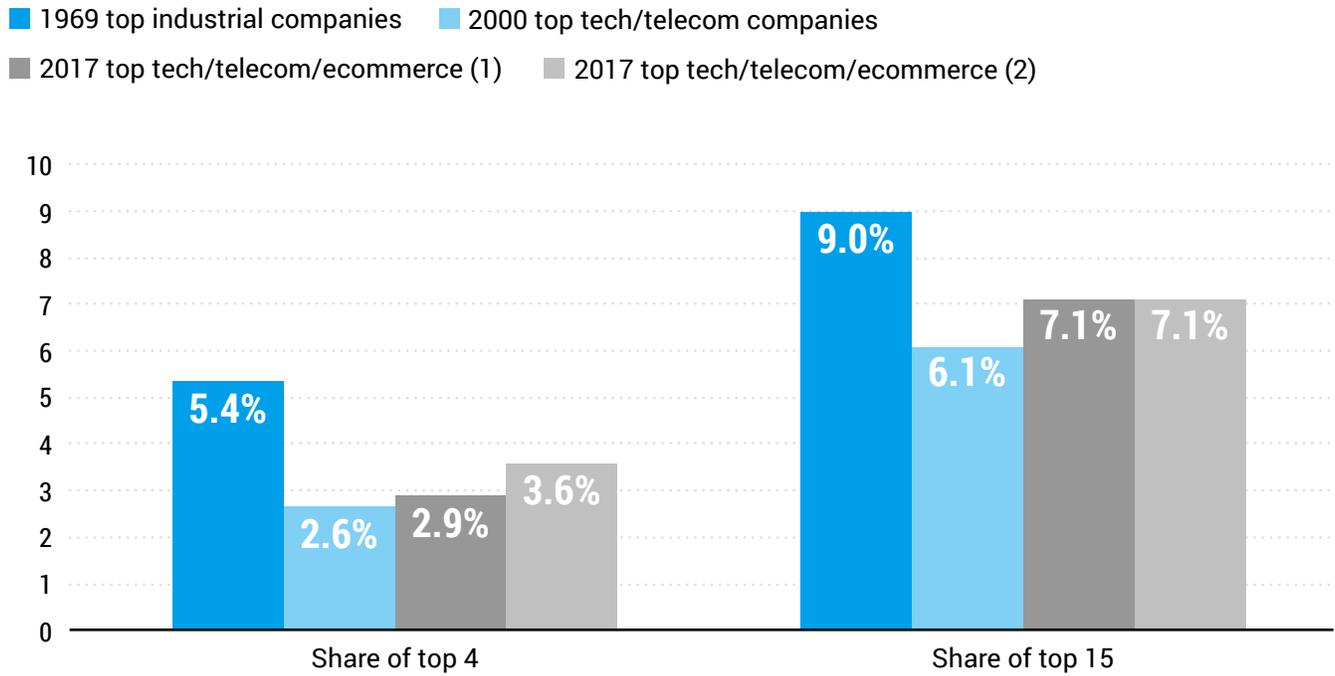
We can make an interesting comparison between 2017 and 2000, the peak of the previous tech boom. In 2000, the top tech/telecom/ecommerce company by sales was IBM. Google was not yet public, Facebook did not yet exist, and Apple and Amazon were way down the list. That year, the revenues of the top 15 tech/telecom/ecommerce companies, ranked by sales, totaled 6.1 percent of U.S. GDP.

Roll ahead, and the revenues of the 15 top tech/telecom/ecommerce companies accounted for 7.1 percent by 2017. However, when benchmarked against global GDP, there was effectively no change in the relative size of the tech/telecom/ecommerce leaders from 2000 to 2017. Global revenues at the U.S. tech/telecom/ecommerce leaders did rise from 2000 to 2017 – but no faster than the expansion of the global economy.

Similar results hold if we change our scope and analyze the U.S. tech/telecom/ecommerce sector, including the domestic operations of large and small companies and the U.S. operations of foreign-based companies.¹⁹ From 2000 to 2017, the value-added in the U.S. digital or tech/telecom/ecommerce sector – including corporate profits and labor compensation – rose at an annual rate of 11.5 percent. That's faster than the 9.6 percent annual growth (in nominal dollars) of the U.S. economy, but considerably slower than the 13.3 percent growth of the global economy (also in nominal dollars). That's why the share of the U.S. tech/telecom/ecommerce sector in global GDP is down from 2.4 percent in 2000 to 2.1 percent in 2017 (Figure 3).

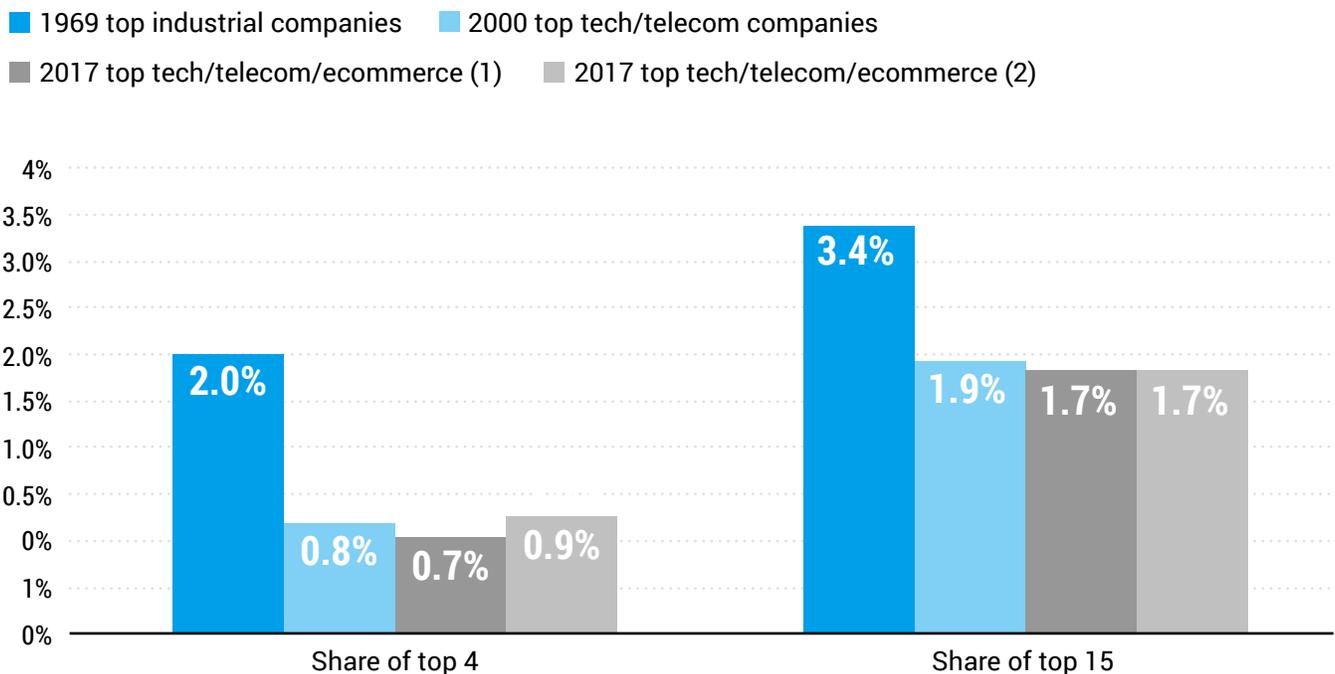
In summary: There's no evidence that today's tech leaders make up a significantly higher share of the U.S. and global economies compared with past industry leaders. That doesn't directly address the questions of competition and concentration, but it does form an essential background.

FIGURE 1: Top Industrial and Digital Companies, 1969, 2000, 2017: Share of U.S. GDP



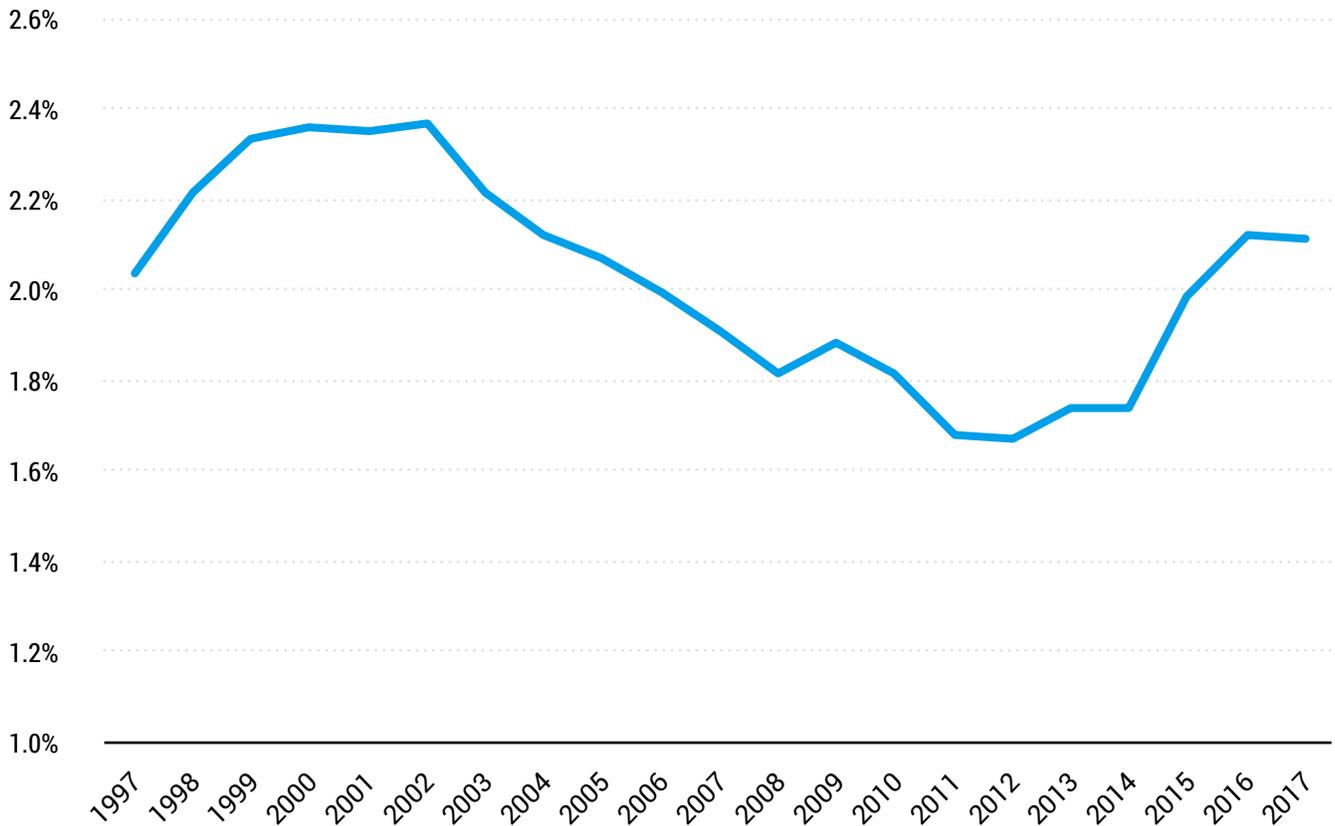
Top companies ranked by revenue. The exception is (1), where the top four companies are Apple, Amazon, Google, and Facebook. Data: Annual reports, BEA, PPI

FIGURE 2: Top Industrial and Digital Companies, 1969, 2000, 2017: Share of World GDP



Top companies ranked by revenue. The exception is (1), where the top four companies are Apple, Amazon, Google, and Facebook. Data: Annual reports, World Bank, BEA, PPI

FIGURE 3: Compared to 2000, U.S. Tech/Telecom/Ecommerce Sector Is a Smaller Share of Global GDP (value-added in U.S. tech/telecom/ecommerce sector as percent of global value-added)



Data: World Bank, BEA, PPI

RELATIVE ECONOMIC PERFORMANCE OF THE TECH/TELECOM/ECOMMERCE SECTOR

When assessing concentration and competition, economic performance matters. In particular, we care about economic variables such as prices, productivity, real wages, hiring and labor share. In a 2017 paper, Carl Shapiro warns that “the coherence and integrity of antitrust require that successful firms not be attacked simply because they obtain dominant positions.”²⁰ Or, to put it another way, we don’t want to trash an industry that is working really well for consumers and workers.

John Van Reenen notes, in a paper presented at the Federal Reserve’s 2018 Jackson Hole meetings, “The industries growing most concentrated appear to have rising productivity and innovation, which is consistent with reallocation to more efficient and innovative firms.”²¹ He further goes on to add:

If the increase in the aggregate markup reflects weakened anti-trust enforcement, this will generally lead to worse allocative efficiency, higher prices, and lower productivity as discussed above. On the other hand, if it is due to tougher markets reallocating more output to the more efficient firms, this should lead to higher productivity.

Table 1 shows key economic performance indicators for the digital sector for the tech boom period 2007-2017, compared to the non-health private economy.²² These results are based on new BEA data released November 1, 2018. These revisions significantly boost the size and performance of the digital sector compared to previously released data.

TABLE 1: How the Digital (Tech/Telecom/Ecommerce) Sector Performed, 2007-2017

	DIGITAL SECTOR	REST OF NON-HEALTH PRIVATE SECTOR
GROWTH AND PRICE MEASURES		
REAL VALUE-ADDED (PERCENTAGE CHANGE)	80.9%	8.8%
PRODUCTIVITY (PERCENTAGE CHANGE)	58.7%	5.3%
PRICE (PERCENTAGE CHANGE)	-14.6%	21.2%
LABOR MEASURES		
FULL-TIME EQUIVALENT JOBS (PERCENTAGE CHANGE)	14.0%	3.3%
REAL ANNUAL PAY PER WORKER (PERCENTAGE CHANGE)	15.4%	7.0%
LABOR SHARE (CHANGE IN PERCENTAGE POINTS)	-0.1	-1.3

Sources: BEA, BLS, and PPI. Data as of 11/1/18

The digital sector consists of computer, communications equipment and semiconductor manufacturing; software and other publishing; video and audio; broadcasting and telecom; data processing, Internet publishing and other information services; computer systems design and related services; and nonstore retail, including ecommerce fulfillment centers.

Table 1 shows that the tech/telecom/ecommerce or digital sector has outperformed the rest of the non-health private sector on key macroeconomic indicators. Productivity in the digital sector rose by 58.7 percent, compared to only 5.3 percent in the rest of the private sector. Because of these gains, the tech/telecom/ecommerce sector accounted for almost half of non-health private sector growth between 2007 and 2017.

If the increase in the aggregate markup reflects weakened anti-trust enforcement, this will generally lead to worse allocative efficiency, higher prices, and lower productivity as discussed above. On the other hand, if it is due to tougher markets reallocating more output to the more efficient firms, this should lead to higher productivity.

Customers benefited from these productivity gains, as prices in the digital sector fell by 14.6 percent in the relevant period, while rising by 21.2 percent in the rest of the non-health private sector. It wasn't just one digital price that fell. Online advertising prices have fallen by more than 40 percent since 2010. Cloud computing prices have been falling at 7 percent per year. Real margins in the electronic shopping industry (NAICS 4541) have fallen by 13 percent since 2007, implying increased competitiveness. These price drops represent real gains to customers.

On the labor side, real annual pay per full-time equivalent in the digital sector rose by 15.4 percent, compared to only 7.0 percent in the rest of the private sector.

Perhaps surprising, full-time equivalent jobs also grew faster in the digital sector, 14.0 percent versus 3.7 percent for the rest of the non-health private sector. Job growth in digital was fueled

by an expansion at a combination of big and small companies, or, rather, once small tech/ecommerce companies becoming larger. For example, Amazon went from 17,000 workers in 2007 to 566,000 in 2017. Apple went from 21,600 workers in 2007 to 123,000 in 2017.

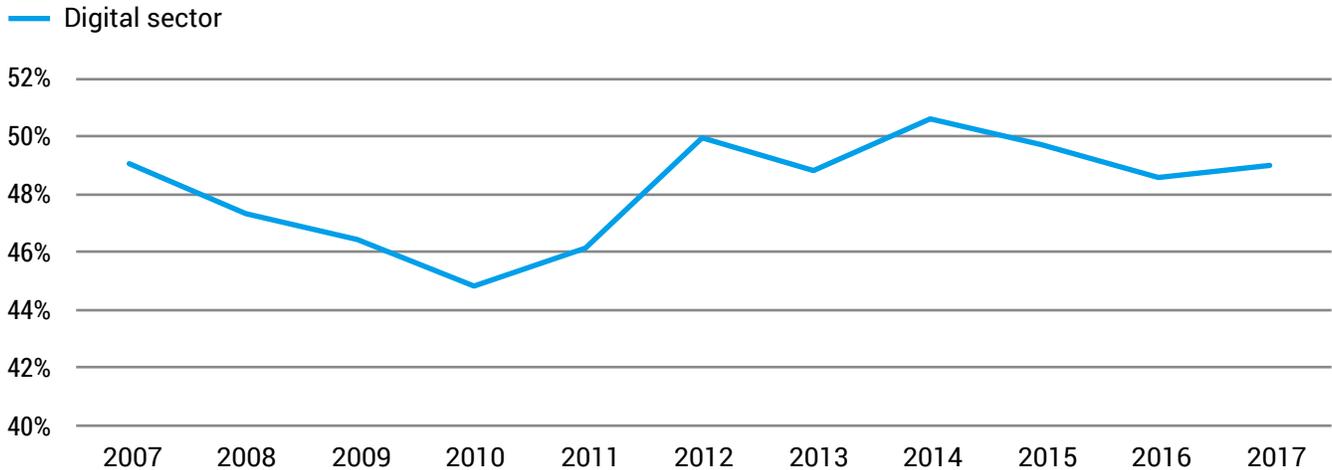
The results for labor share are particularly interesting. Labor share is a good summary measure of how much of the income of an industry is going to workers. For the purposes of this paper, we define the labor share as labor compensation divided by value added, expressed as a percentage.²³

Since the tech boom started in 2007, labor share for the digital sector is effectively unchanged (Figure 4). That means workers have been getting a steady share of the rising value added generated by the digital economy. By contrast, labor share in the rest of the non-health private sector fell by 1.3 percentage points over the same period.

The patterns over time are interesting. Labor share fell in both the digital sector and the rest of the non-health private sector during the recession. But the labor share recovered in the digital sector as the tech boom continued, but never recovered in the rest of the private sector.

The differing trends in the digital sector and the rest of the non-health private sector are suggestive. The tech/telecom/ecommerce companies are doing a better job of generating productivity growth than their counterparts elsewhere in the private sector. Moreover, the tech/telecom/ecommerce sector is doing a better job of sharing that productivity growth through higher real wage growth and falling prices. So, if we take seriously the notion that the goals of competition policy have been broadened to economic variables such as labor share, the companies in the digital sector are performing well.

FIGURE 4: Labor Share in the Digital Sector Falls and Then Rebounds (labor compensation as share of value added*)



*Including nonfarm proprietors' income. Data: BEA, PPI

By contrast, the data show that non-digital companies are less good at sharing what little productivity growth they have been generating. The falling labor share, in particular, is a sign that workers are falling behind in non-digital industries. In other words, these indicators make a prima facie case for directing the attention of competition policy to non-digital industries.

WHY MARKET SHARE NUMBERS ARE A MISLEADING GUIDE TO COMPETITIVENESS

The second half of the paper examines the competitive pressures on the tech/telecom/ecommerce companies. These companies do appear to have a very large share of their individual activity by conventional metrics. The usual numbers cited are Google, with roughly 85 percent of desktop search in the United States – which doesn't account for the large number of searches done within sites such as Amazon, LinkedIn, and Etsy – and Amazon, with an estimated U.S. ecommerce share of just under 50 percent, including sales of third-party sellers using Amazon Marketplace.²⁷ A recent Pew

Research Center survey shows that 68 percent of U.S. adults use Facebook, and, out of those, roughly half visit multiple times daily.²⁸

The strong economic performance of the tech/telecom/ecommerce sector across a range of measures makes it less likely that the tech giants are engaging in anticompetitive behavior on a wide scale. In order to understand why this might be true, we address a range of issues and particular markets:

- Multi-sided markets and platforms
- Online retail
- Online advertising
- Multi-homing and network effects
- Data feedback loops and barriers to entry
- Competition in the cloud computing market
- The rise of new platforms in physical industries such as manufacturing and healthcare

- The rise of global competition in the tech/telecom/ecommerce space

We note that this is not a complete list of relevant issues. In particular, we are not treating the thorny issues of net neutrality and privacy. Moreover, regulators need to be alert for anticompetitive behavior in the tech markets, such as unfairly blocking new entrants. Indeed, nothing in this paper should be viewed as exonerating or excusing poor behavior on the part of market leaders.

But the continued presence of strong competition from multiple directions, as we will see, makes such anticompetitive behavior less likely.

MULTI-SIDED MARKETS AND PLATFORMS

The largest tech companies are important players in multi-sided markets, also known as digital platforms. Multi-sided markets are defined as online markets or platforms where the digital company that owns the platform brings together two or more groups of users for beneficial transactions. Examples of multi-sided markets include ride-sharing platforms, which bring together riders and drivers; ecommerce platforms, which bring together buyers and sellers; app stores, which bring together app developers and app users; and online search, which brings together consumers and advertisers.

The typical rules of thumb for assessing concentration do not work well with multi-sided markets. The nature of a multi-sided market is that the platform may serve a large share of users in one market, while still facing strict competitive pressures in the linked market. A recent report from the OECD concluded that, "given the interrelationship of pricing across the platform, it is not meaningful to conclude that a platform has market power on one side of the platform."²⁹

Moreover, digital platforms face important economic and competitive constraints.

In particular, because platforms serve as intermediaries, they have a strong incentive to maintain user trust.³⁰ If that trust is broken, then it is easy for users to find an alternative platform, limiting the potential market power. For example, iOS and Android are separate mobile operating systems, associated with separate app stores. However, app developers often create apps for both iOS and Android. A search through job postings on Indeed.com shows that there are roughly 24,000 job postings that contain either the terms "iOS" or "Android". Out of those, roughly 45 percent contain both terms, typically linked to a job posting for a developer familiar with both operating systems. Thus, it is relatively simple for app developers to shift their priorities between systems.

Finally, conventional economic statistics often do not capture the efficiencies generated by digital platforms. Consider ecommerce platforms, for example. In recent years, there has been strong growth in U.S. ecommerce fulfillment and delivery jobs without a corresponding decline in brick-and-mortar jobs. Since 2007, the total number of full-time-equivalent jobs in the retail, courier and messenger, and warehousing industries is up 600,000, or 4.5 percent. That's only slightly slower than the overall growth rate of non-health private sector FTE jobs.

So where are the productivity gains coming from? It turns out there has been a significant drop in the number of hours that households spend shopping each week, roughly paralleling the rise of ecommerce.³¹ From 2007 to 2017, the average amount of time spent shopping for consumer goods or travelling for purchases

of goods and services declined by roughly 20 minutes per week. That doesn't sound like much, but, given that there are 260 million adults in the U.S., that's equivalent to a decline of 90 million hours per week in shopping time, or more than 2 million FTE jobs.

In other words, any analysis of the efficiency gains from ecommerce platforms has to take into account the impact on non-market time of households. Similarly, competitive analysis of any multi-sided market and platform that includes consumers must take into account the efficiency gains on household use of time.

ONLINE RETAIL

In order to assess competition and concentration in the tech industries, it's essential to be looking at the right markets. Ecommerce is an important example of how market boundaries can evolve over time. Originally ecommerce sellers, with their long delivery times, could not match the immediacy of in-person purchases. Moreover, ecommerce did not offer the ability to try on clothing, which is important for many consumers. Thus, it was only natural to treat ecommerce as a distinct market from brick-and-mortar.

But, over time, ecommerce sellers such as Amazon intentionally moved toward a policy of rapid free delivery for many products and easy returns. Amazon, in particular, built out a large network of fulfillment centers to shorten delivery times and accept returns. As a result, ecommerce evolved and became a close substitute for brick-and-mortar, even for clothing.

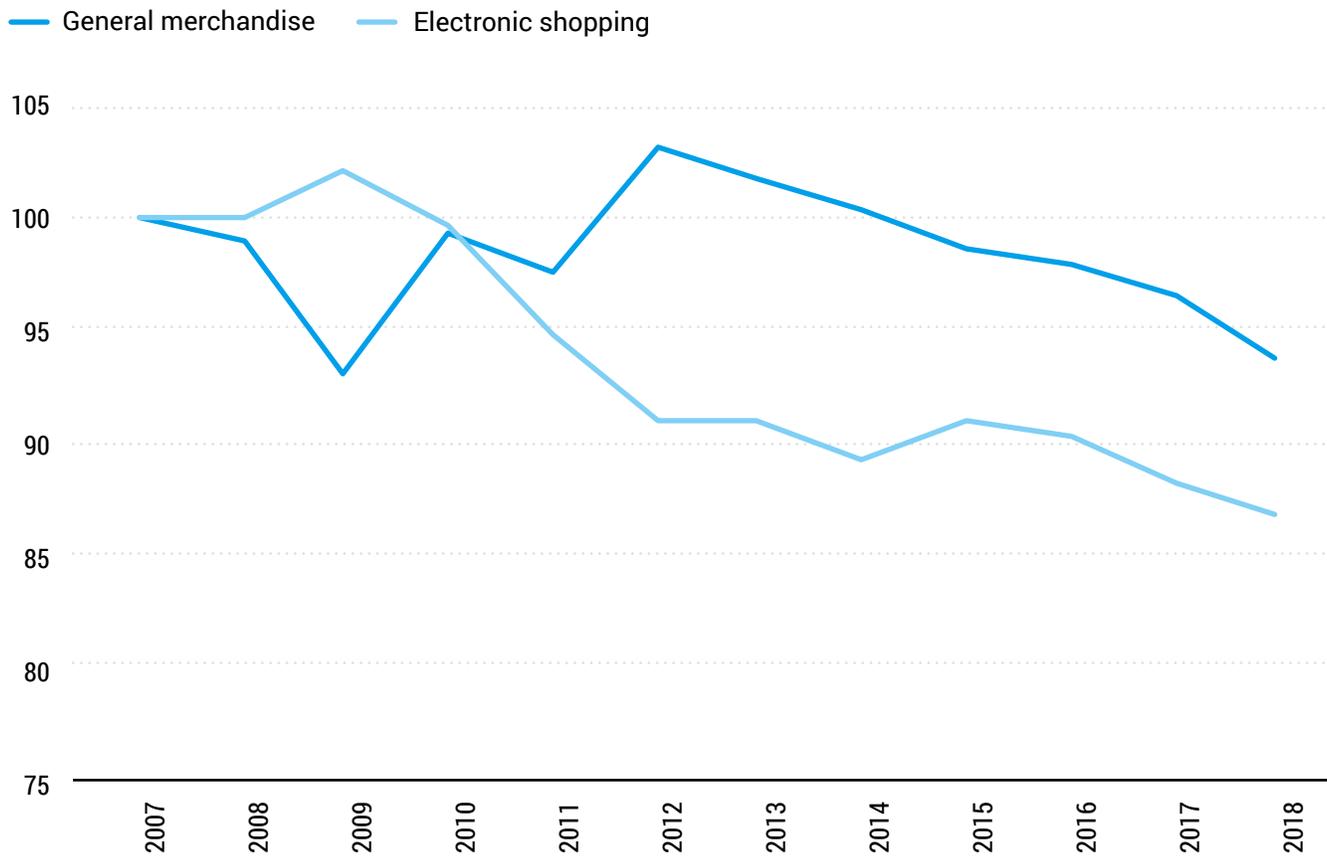
For example, customers could order several pairs of shoes, try them on at home, and then simply return the ones that didn't fit.

That suggests ecommerce should be treated as part of the overall retail market, rather than a separate market. Today, the pricing policy of ecommerce sellers has a powerful impact on sales by the brick-and-mortar retailers. A sustained 10 percent increase in ecommerce prices for shoes, for example, would likely cause some shoe buyers to switch from online to brick-and-mortar.

Viewed from this perspective, Amazon accounts for only 5 percent of U.S. retail sales, on average. Out of that figure, according to eMarketer, one-third is Amazon direct sales, and two-thirds comes from third-party sellers operating through the Amazon Marketplace.³²

One direct measure of competitive pressure is whether ecommerce companies have been able to use market power to raise their markups or margins. As part of its program for measuring producer prices across the economy, the BLS tracks margins for different retail industries, where margin is defined as prices received by retailers less their acquisition price of goods.³³ Real margins in the electronic shopping industry (NAICS 4541) have fallen by 13 percent since 2007, implying increased competitiveness (Figure 5). Meanwhile real margins in the general merchandise industry, including department stores and big box retailers, have fallen by only 6 percent.

FIGURE 5: Real Margins Plunge for U.S. Electronic Shopping Industry (2007=100)



Real margins are calculated by deflating the producer price index for the respective retail industry by the consumer price index.

Data: BLS Chart: PPI

It's worth noting that part of the attraction of selling through the Amazon Marketplace includes the ability to use Amazon's ecommerce fulfillment services. This is a very important competition point that will be considered later in this paper, in the section on physical sector platforms. For now, it suffices to say that there's a large and active market of third-party ecommerce fulfillment companies.³⁴

ONLINE ADVERTISING

The free services offered to consumers by companies such as Google and Facebook are funded by revenues from advertisers. So, if these companies have pricing power, it's going to be seen in the advertising market – where

Google and Facebook are charging a price and collecting money – rather than in the consumer market, where the price is zero.

Should competition regulators look at Google and Facebook's share of the online advertising market, or should their advertising revenues be compared to the total advertising market? As in the case of ecommerce, the nature of Internet advertising has evolved. Internet advertising and television used to be seen as different markets, when online advertising was mostly display ads as compared to highly-produced television commercials. Now they are increasingly seen as overlapping markets.

Notes Zenith Media:

...the platforms are now competing with television more directly by hosting long-form content like sport, drama and comedy, and inserting mid-roll ads like those seen in television breaks.³⁵

So, increasingly, the appropriate market is all advertising, and not just online. In 2018, Internet advertising accounted for roughly 40 percent of all global advertising spending, followed closely by television.³⁶

Moreover, if prices are any guide, it looks like sellers of television advertising have more market power than sellers of Internet advertising. According to the Bureau of Labor Statistics, the price of Internet advertising has dropped more than 40 percent since 2010, while the price of television advertising has remained flat (Figure 6).

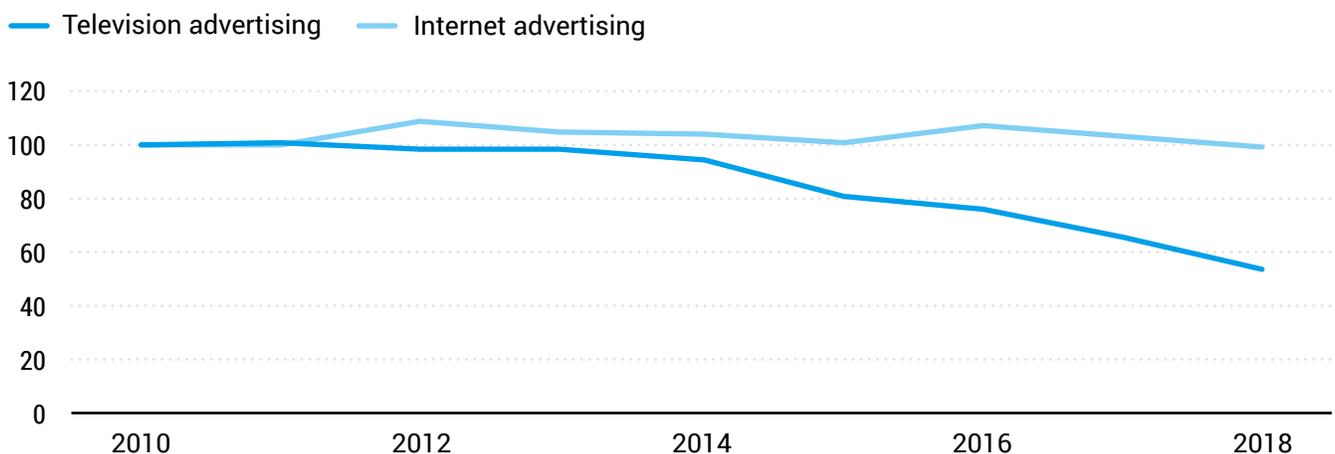
Once again quoting from Zenith Media:

The supply of online video audiences has been growing ahead of demand in recent years: online video viewing grew 91 percent between 2015 and 2017, while adspend grew 52 percent. The cost of online video advertising has therefore come down substantially.³⁷

In other words, Internet advertising has become relatively cheaper compared to television advertising.

The fall in the price of Internet advertising has benefited advertisers by making it easier for them to place more ads. This may or may not be a good thing for consumers. But it does suggest that advertisers are not facing a market where a few platforms are squeezing prices.

Figure 6: Prices for Internet Advertising Have Plummeted (2010=100)



Data: Bureau of Labor Statistics

MULTI-HOMING AND NETWORK EFFECTS

As we consider the link between concentration and competition in tech markets, the term "network effects" looms large. Network effects means that the more people who join a network, the more appealing it is for others to join as long as it doesn't suffer from congestion.

By itself, a network effect would imply that, once a network gets a large enough share of the relevant market, it becomes entrenched and hard to challenge. By this reasoning, Facebook's large share of the social media market means it will never have a viable challenger.

In practice, however, the network effect is attenuated by "multi-homing," which was originally a technical term for attaching the same computer or server to more than one network.³⁸ The term has been extended to participants belonging to more than one social network or platform.

It's relatively easy for consumers of businesses that use one social network to add another one as well. A 2018 study from the Pew Research Center shows that "many Americans use multiple social platforms." The study goes on to say that:

Roughly three-quarters of the public (73 percent) uses more than one of the eight platforms measured in this survey, and the typical (median) American uses three of these sites. As might be expected, younger adults tend to use a greater variety of social media platforms. The median 18- to 29-year-old uses four of these platforms, but that figure drops to three among 30- to 49-year-olds, to two among 50- to 64-year-olds and to one among those 65 and older.³⁹

Pew finds that, among 18- to 24-year-olds, 80 percent use Facebook and 78 percent use SnapChat. These results suggest that digital

natives feel comfortable switching back and forth among platforms.

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DATA FEEDBACK LOOPS AND BARRIERS TO ENTRY

In this section we will consider the implications of data for competition. An important structural issue is whether the ability of tech companies to amass large amounts of data will become an unbreakable barrier to entry.⁴⁰ This fear is emphasized by the persistent analogy between data and oil – made famous by the Economist cover story from May 2017 – which suggests that data is a limited resource that can be monopolized, in the same way that Standard Oil monopolized petroleum.

However, the analogy between oil and data completely collapses under close examination. In particular, oil is in fixed supply, whereas more data is being generated all the time. Equally important, each barrel of oil can have only one owner, whereas the same data (such as your address) can be given out an infinite number of times.⁴¹ Similarly, location data is available to a wide range of firms, since many apps ping location data.

A more sophisticated argument about data and market power revolves around the "data feedback loop." The idea is that a company with a large amount of data about its customers can use that data to make its products and services more attractive. Those improvements, in turn, draw in more customers, which generates more data to better improve the products and services.

On one level, the concept of a data feedback loop is a truism. All companies have information about how their customers respond to their current generation of products. In order to forecast consumer response to new products, they collect additional data via focus groups or consumer surveys, or by buying broader market

data, up to the point that the cost of collection is equal to the value of the new data.

In such situations, companies typically face a diminishing marginal value of additional data. They could run more focus groups or surveys, but the added expense typically won't change the qualitative conclusions.⁴²

TABLE 2: How Oil and Data Are Different

OIL	DATA
Fixed supply, created millions of years ago. We can improve our discovery techniques, but the supply is still limited.	Exponentially increasing supply, with new types of data being created everyday.
Because its supply is fixed, oil can be easily controlled by a small number of players, allowing them to drive up the price.	The supply of data is soaring in both volume and type so rapidly that it cannot be controlled or monopolized. Value is generated by new types of analysis rather than ownership of the data.
Unused oil in the ground has a value, set by supply and demand.	Unused data, by itself, has uncertain economic value. Its value depends on how it is combined and used with other data.
Once a barrel of oil is refined and consumed, it's gone.	Data can be duplicated, shared, and reused.
Oil is the single biggest commodity traded on international markets, with the nationality and location of oil reserves and extracted oil tracked very closely. Every barrel of oil that is exported is one less to be consumed at home.	Data can be "exported" to another country without reducing the amount to be used at home. For that reason, it is better to speak of global connections rather than exports and imports of data.

The “data feedback loop” is supposedly different because of potential economies of scale. By collecting and analyzing data across different products or for longer historical periods, tech platforms such as Google and Amazon are supposedly able to escape the trap of diminishing marginal value of data, and create barriers to entry.

Clearly there are situations where more data makes a big difference. Mapping programs, for example, require continual updating to ensure that routes are accurate and don't send drivers to roads that no longer exist. The accuracy of translation programs improves with more data.⁴³

But new research suggests diminishing returns to scale to data in some important platform-related situations. In a 2017 paper, Lesley Chiou and Catherine Tucker found little evidence that the possession of historical data conferred large advantages in search engine results.⁴⁴ In other words, a new entrant to the search market would not suffer from a lack of historical data.

Patrick Bajari, chief economist at Amazon, recently worked with two academic economists to answer the question: Does having access to more data allow Amazon to improve forecasts of consumer demand for particular products?⁴⁵ They found that, as more and more data was available for a particular product, demand forecasts for that product improved over time. However, the improvements had diminishing returns to scale. Perhaps more important, aggregating data across different products did not seem to be associated with increases in forecast performance.

These results suggest that the data feedback loop, while powerful, still has diminishing returns to scale. We note, for example, that Google still gets 86 percent of its revenues from advertising,

implying that data does not immediately create the ability to move into new markets.

Indeed, data does not confer protection against disruptive innovation. Anja Lambrecht and Catherine Tucker observe that:

...the rise of the new “sharing economy” provides evidence that to build up entirely new digital industries in traditional sectors does not require access to big data. Uber and Lyft had no superior access to data compared to established taxi services, but they were better at putting together a product that met consumer needs for a convenient and reliable taxi service. AirBnB entered a highly competitive industry where large travel companies have access to large swathes of data and regularly run experiments to interpret their data in a meaningful way to constantly improve business practices. Yet, despite the lack of data, AirBnB quickly became a dominant player because of its superior value proposition.⁴⁶

Later in this paper we will examine the role of competition from new platforms in physical industries.

COMPETITION IN THE CLOUD COMPUTING MARKET

If possession of data does not create barriers to entry, then perhaps limited access to computing power for data analysis does? In fact, economies of scale are allowing the major cloud providers to provide advanced computation capabilities more widely, including machine learning.

Recent economic research suggests that the price of cloud computing has been falling. Economists David Byrne, Carol Corrado and Daniel Sichel estimate that prices for the Amazon Web Services (AWS) compute product

fell at an average rate of about 7 percent during 2000-2016. Price declines were slower before 2014 and more rapid starting in the beginning of 2014.⁴⁷ As recently as August 2018, Google cut the monthly cost of storage in half.⁴⁸ Some analysts find equally fast drops in the recent prices for cloud computing, though not everyone agrees.^{49,50}

Interestingly enough, the cloud boom may be causing the economic statistics to understate tech investment. Large cloud providers such as Amazon and Google appear to be assembling their own servers from parts.⁵¹ Byrne and his colleagues suggest that this investment is not being properly calculated in the national income accounts. They estimate that, if this own-account investment were included in business IT investment, then the growth rate of real investment in IT equipment during 2007-2015 would have averaged two percentage points higher, which would significantly reduce the apparent investment shortfall in the tech industries.

One danger with cloud computing is the possibility of lock-in, meaning companies are tied into one cloud provider. But enterprises especially have been using methodologies such as containers that make applications more portable between different cloud providers. As a result, one analyst writes:

AWS has nothing like the monopoly status that IBM System/360 and System/370 mainframes enjoyed four decades ago in corporate computing. It will be hard for AWS to get a monopoly as long as other hyperscalers – particularly Microsoft and Google, and possibly Facebook if it needs to make its IT costs lower – who have public-facing applications also provide cloud services to customers.⁵²

Competition in the cloud computing market means cloud providers are making tools such as artificial intelligence and machine learning widely available, not just to startups but to existing companies.⁵³ We can assume that the cloud providers are not selling access to their latest generation of technologies. Nevertheless, the wide dissemination of artificial intelligence and machine learning techniques has potential for accelerating productivity growth across the entire economy.

THE RISE OF NEW PLATFORMS IN PHYSICAL INDUSTRIES SUCH AS MANUFACTURING AND HEALTHCARE

So far we have considered competition within the tech/telecom/ecommerce space. The leading companies play a key role in industries such as communication; advertising; retail; and, to an increasing degree, distribution.

But it's important to remember that much of the "physical" economy – such as key industries like manufacturing, construction, and healthcare – have been much slower to digitize. For example, computer occupations accounts for less than 1 percent of healthcare employment, even after the big push to move to electronic health records. Taking into account various metrics, roughly only about 20-30 percent of the economy is digitized.⁵⁴

That will change, however, as the next decade will see the digitization of physical industries. In manufacturing, for example, the growth of robots and 3D will give manufacturers the ability to efficiently fulfill small-batch or custom production runs without incurring heavy retooling costs.

Moreover, the digitization of manufacturing production will lead to industrial companies creating manufacturing platforms, both open and proprietary.

...These platforms would be analogous to today's multi-sided Internet platforms, like app stores, social media, or advertising networks. Platforms are built upon a ceaseless flow of small packets of data that are rapidly routed to the desired destination. By contrast, these new manufacturing platforms would be mixed cyber-physical systems consisting of functions such as design, production, and distribution running as separate services on top of an advanced distribution network of goods.

These new platforms – in manufacturing, in healthcare, in construction, in transportation – have the potential to be formidable competitors to the existing tech leaders. For example, current systems for handling electronic healthcare records focus mainly on claims data. The next-generation healthcare platform will be based on actual detailed clinical data, which will likely require direct connections to medical equipment.

The best current example of a physical sector platform is Amazon's network of fulfillment centers, which has revolutionized the distribution of individual items to consumers. Before Amazon, it was simply not cost effective to quickly sort and ship individual items to consumers. Instead, most consumer goods were shipped in huge containers to big box stores, where they were dumped in big mountains for consumers to pick through for their size and preferred style.

The digitization of warehouses turned ecommerce fulfillment centers into the equivalent of network routing nodes, taking in goods from manufacturers and third-party sellers, storing and sorting them, and sending out individual "packages" to consumers. This also includes efficiently handling returns, which

is the physical equivalent of a request for retransmission.

Even here, the ecommerce fulfillment centers deal with only a small part of the distribution chain. The digitization of manufacturing and transportation will create new platforms as well, rivaling the existing tech companies.

THE RISE OF GLOBAL COMPETITION IN THE TECH/TELECOM/ECOMMERCE SPACE

Finally, we need to consider the role of global competition. Historically, assessing the geographic bounds of a market was an important consideration in measuring concentration and competition. But conceptually, the tech/telecom/ecommerce markets are global. Unless restricted by government or business policy, consumers can tap into websites anywhere around the world and, in theory, download digital goods or place an ecommerce order.

Moreover, individuals and businesses can participate in multiple platforms based in different countries. A business can sell through Amazon in the U.S., Rakuten in Japan, and Jingdong or Alibaba in China. Sites like wish.com allow Chinese manufacturers to sell directly to U.S. consumers. Even if such sales are relatively small right now, these platforms have the scale to quickly expand across borders in the same way that global retailers such as Aldi have expanded in the U.S.

European rules in areas such as data privacy acknowledge the global nature of the Internet. The General Data Protection Regulation (GDPR) applies to companies with customers in Europe, even if the business has no employees there.

In that sense, antitrust regulators should weigh the potential global competition when

considering concentration in U.S. markets. That's why, in the early part of this paper, it was relevant to compare the size of the tech/telecom/e-commerce leaders with the size of the global economy.

CONCLUSION

In terms of policy, our conclusions suggest a sector-agnostic approach to competition policy. The evidence does not indicate that the tech leaders pose a special problem. From the macro perspective, we find that the relative size of the tech/telecom/e-commerce leaders has barely changed since 2000. Revenues at the U.S. tech/telecom/e-commerce leaders did rise from 2000 to 2017 – but no faster than the expansion of the global economy.

We also find that the tech/telecom/e-commerce sector has outperformed the rest of the private sector across a wide range of important economic measures since the tech boom

started in 2007. Prices in the tech/telecom/e-commerce sector have fallen; productivity has risen much faster than the rest of the private sector; real wage growth has been higher; and job growth has been faster.

Notably, the labor share in the tech/telecom/e-commerce sector has been flat since 2007. Thus, the macro evidence suggests that the evolution of the tech/telecom/e-commerce sector over the past decade has been beneficial to consumers and workers.

The analysis in this paper is not intended to exempt tech/telecom/e-commerce companies from antitrust scrutiny. Regulators need to be alert for potential problems, but the strong economic performance of the tech/telecom/e-commerce sector across a range of measures makes it less likely that the tech giants have been engaging in anticompetitive behavior on a wide scale.

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